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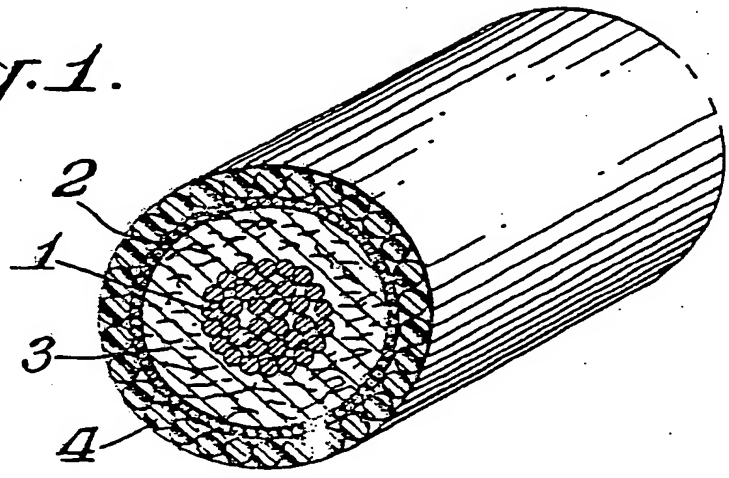
(54) Leakage sensor for electrically conductive liquids.

(57) A leakage sensor for detecting leakage of electrically conductive liquids is provided in the form of a coaxial cable and comprises a core conductor (1), an electrically insulating material (3) surrounding the core conductor (1) and capable of absorbing the electrically conductive liquid to be detected, and an outer conductor (2) formed by a liquid permeable, conductive shield surrounding and in contact with the insulating material (3).

Fig. 1.



EP 0 341 933 A2

LEAKAGE SENSOR FOR ELECTRICALLY CONDUCTIVE LIQUIDS

The pr sent invention relates to a leakage sensor in coaxial cable form for detecting leakage of electrically conductive liquids.

Japanese Patent Publication No. 59-47256 discloses a sensor in coaxial cable form designed for the detection of electrically non-conductive fluids. This sensor comprises a continuously porous polyt trafluoroethylene (PTFE) material which contains an electrically conductive substance, the material b ing installed between a core conductor and an outer shielding conductor. Leaking oil or various types of gases can penetrate into the PTFE material, causing a drop in the electrical conductivity between the conductors, and leakage is thus detected by electrically detecting this drop in conductivity.

The PTFE material is water-repellent rather than hydrophilic, and hence the sensor is unsuitable for the detection of electrically conductive liquids such as water and aqueous solutions.

According to the present invention there is provided a leakage sensor for detecting leakage of lectrically conductive liquids, the sensor being in the form of a coaxial cable and comprising an lectrically conductive core, an electrically insulating material which surrounds the core and is capable of absorbing the electrically conductive liquid to be detected, and a liquid permeable, electrically conductive shield surrounding and in contact with the insulating material.

The insulating material may comprise a nonwoven fabric of polyester fibres.

For some applications the sensor may have a layer of aluminium foil surrounding the shield.

The sensor may have a protective outer layer comprising a liquid permeable fabric.

In operation, when an electrically conductive liquid leaking from an object reaches a sensor in accordance with the invention, the liquid passes through the liquid permeable shield and penetrates into the liquid absorbing material surrounding the central core. The core and the shield are thus bridged by this liquid so that the electrical resistance between the two conductors formed by the core and the shield decreases. This change is measured electrically and, as a result, the leakage of the conductive liquid is detected. The leakage could also be detected by measuring the change in the imp dance, capacitance or loss angle occurring between the conductors when the conductive liquid penetrates into the liquid absorbing, insulating material.

Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a part perspective, part cross-sectional view of a first example of a leakage sensor in accordance with the invention; and,

Figure 2 is a part perspective, part cross-sectional view of a second example of a leakage sensor in accordance with the invention.

In the first embodiment shown in Figure 1 the sensor comprises a core conductor 1 made up of twisted strands of wire, and a braided, liquid permeable shield forming an outer conductor 2. A liquid absorbing, electrically insulating material 3 is installed between the core conductor 1 and the liquid permeable outer conductor 2, so that the liquid absorbing material 3 is in contact with both of the conductors 1,2. The liquid absorbing material 3 preferably comprises a non-woven fabric of polyester fibres, and is wrapped spirally around the circumference of the core conductor 1. The liquid absorbing material 3 is capable of thoroughly and rapidly absorbing conductive liquids, such as water and aqueous solutions of acids and alkalis. An outer protective covering 4, such as braided polyester fabric, which is permeable to the conductive liquids is installed around the periphery of the outer conductor 2.

Before use, the sensor is first cut to an appropriate length, and the terminals of the two conductors 1,2 are connected to a suitable detection circuit. When leakage occurs and the liquid reaches the periphery of the sensor, the leaking liquid passes through the protective outer covering 4, through the liquid permeable outer conductor 2, and is absorbed by the liquid absorbing material 3. Accordingly, the liquid forms an electrically conductive bridge between the core conductor 1 and the outer conductor 2. The change in the electrical resistance between the conductors 1,2, which occurs as a result of this bridge, is measured by the detection circuit, and the leakage is thereby detected.

In this case, because the leaking liquid is absorbed by the liquid absorbing material 3, even a small amount of liquid can be detected. The amount of liquid that is absorbed can be increased or decreased by adjusting the thickness of the liquid absorbing material 3, and in this way the detection sensitivity of the sensor can be adjusted.

In the second embodiment shown in Figure 2, the sensor comprises a core conductor 1 made up of twisted strands of wire, a braided, liquid permeable shield forming an outer conductor 2, and a liquid absorbing, electrically insulating material 3 installed between the core conductor 1 and the liquid permeable outer conductor 2 so that the

liquid absorbing material 3 is in contact with both of the conductors 1,2. To this point, the construction is the same as in th first embodiment.

The s nsor in this embodiment, however, is designed to be used to detect leakage of aqueous acid or alkali solutions, and has an aluminium foil tape 5 wrapped spirally around the periphery of the liquid permeable outer conductor 2. Outside the aluminium foil tape 5 the sensor has a protective braided layer 6 made of a polyester resin which allows the passage of aqueous liquids therethrough.

In use, a neutral liquid penetrating the protective outer layer 6 of the sensor will be blocked by the aluminium foil tape 5 and will not be detected. However, if an acid or alkali solution should penetrate the layer 6, the aluminium foil tape 5 will dissolve so that the liquid can penetrate further into the sensor, passing through the liquid permeable outer conductor 2 for absorption by the liquid absorbing material 3 and causing the conductors 1,2 to be electrically bridged. This causes a change in the impedance between the conductors 1,2, and the leakage can thus be detected by measuring the impedance change with a detector which is connected to the conductors. In this case as well, the liquid absorbing material 3 reliably and rapidly absorbs the leaking liquid, so that a relatively small leakage can be detected with high sensitivity.

As has been described hereinbefore, a sensor in accordance with the ivention comprises a liquid absorbing insulating material which absorbs electrically conductive liquids and is installed between a core conductor and a liquid permeable outer conductor. Any leaking conductive liquid contacting the sensor is reliably and rapidly absorbed by the liquid absorbing material and the conductors are bridged. As a result, the leakage can be detected by measuring the change in the resistance between the conductors. Since even a small amount of leaking liquid will be absorbed by the liquid absorbing material, high-sensitivity detection is possible. Furthermore, since the sensor is in the form of a coaxial cable, leakage can also be accurately detected by measuring the change in impedance that occurs when the leaking conductive liquid is absorbed by the liquid absorbing material.

Claims

1. A leakage sensor for detecting leakage of electrically conductive liquids, the sensor being in the form of a coaxial cable and comprising an electrically conductive core (1), an electrically insulating material (3) which surrounds the cor (1) and is capable of absorbing the lectrically conductive liquid to be detected, and a liquid permeable, electrically conductive shield (2) surrounding and in contact with the insulating material (3).

2. A sensor according to claim 1 wherein the insulating material (3) comprises a non-woven fabric of polyester fibres.

3. A sensor according to claim 1 or claim 2 having a layer of aluminium foil (5) surrounding the shield (2).

4. A sensor according to any one of claims 1 to 3, having a protective outer layer (4;6) comprising a liquid permeable fabric.

Fig.1.

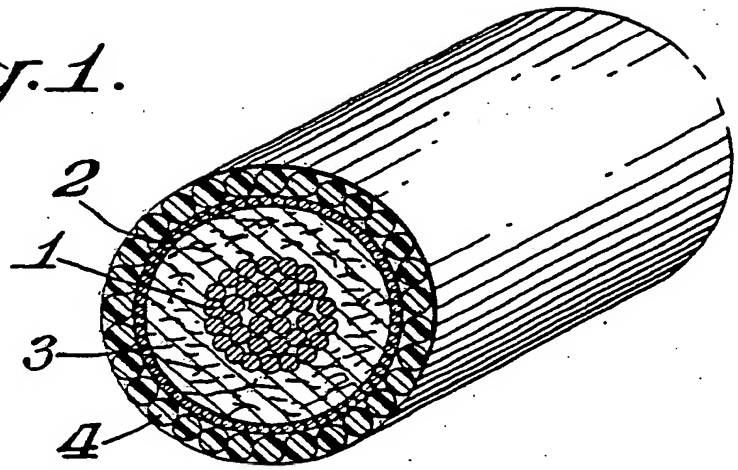
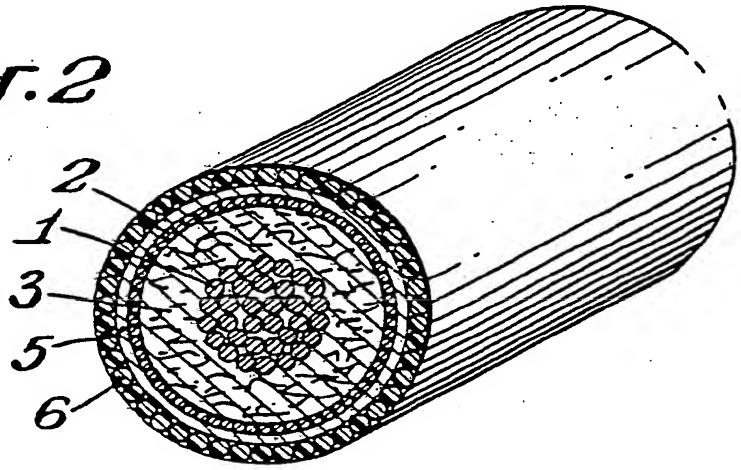


Fig.2



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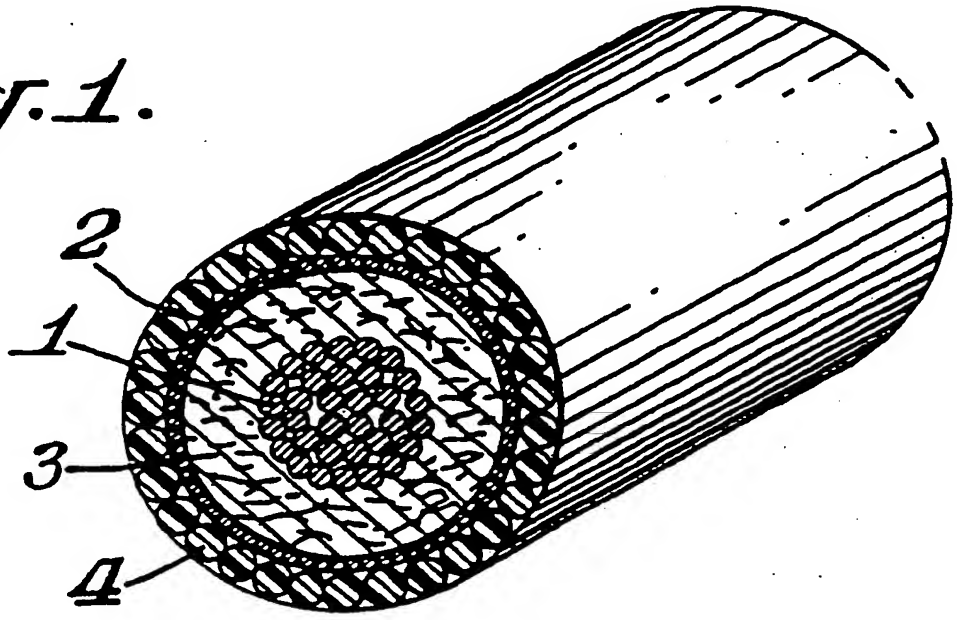

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EUROPEAN SEARCH REPORT

Application Number

EP 89 30 4582

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	EP-A-0 170 174 (W.L. GORE & CO GMBH) * page 5, lines 14-24 *	1,3	G 01 M 3/04 G 01 M 3/16
A	PATENT ABSTRACTS OF JAPAN vol. 10, no. 198 (P-476)(2254), 11 July 1986; & JP - A - 61 41 153 (CANON INC.) 27.02.1986	2	
A	DE-A-3 441 924 (JUNKOSHA CO. LTD.) * page 10 *	4	
A	EP-A-0 262 667 (TATSUTA ELECTRIC WIRE & CABLE CO. LTD.) * page 6, line 28 *	1-4	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

G 01 M 3/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	27-02-1990	DIETRICH A.

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